(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 March 2001 (01.03.2001)

PCT

(10) International Publication Number
WO 01/13802 A1

(51) International Patent Classification[7]: A61B 17/14

(21) International Application Number: PCT/KR99/00717

(22) International Filing Date:
29 November 1999 (29.11.1999)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1999/34321 19 August 1999 (19.08.1999) KR

(71) Applicant and
(72) Inventor: LEE, Hee-young [KR/KR]; 787-14, Samhak-dong, Kunsan 373-310, Cholrabukdo (KR).

(74) Agent: CHANG, Ill-Hwan; 34-2, gosa-dong, Wansangu, Chonju 560-060, Cholrabukdo (KR).

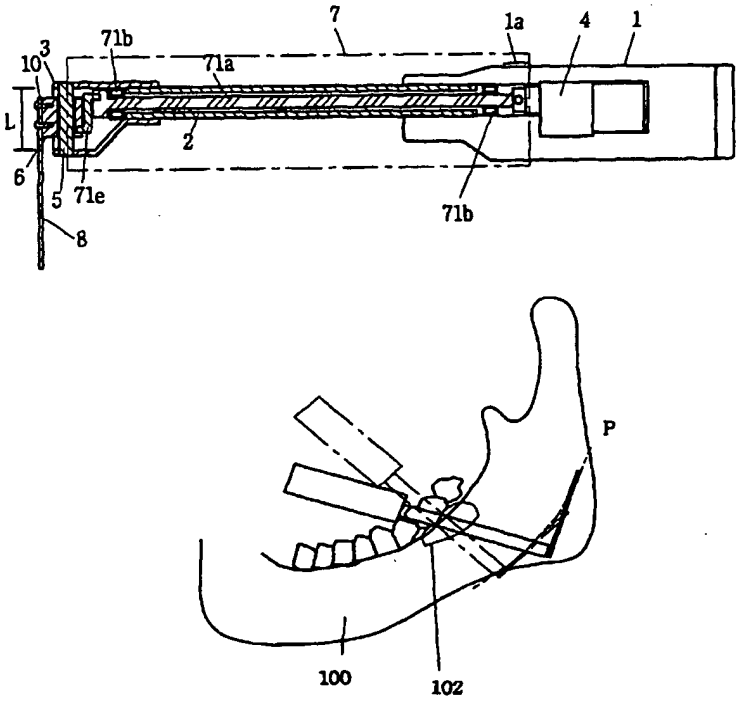
(81) Designated States *(national)*: CA, CN, JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RECIPROCATING SAW FOR USE IN VARIABLE ANGLE AND MULTIPLE DIRECTION



(57) Abstract: A reciprocating saw for use in intraoral bone surgery particularity mandibular angle resection, in which the saw consists of a handle (1), a neck (2) extended from the handle (1), and a head case (3) to be coupled to an end of the neck (2), a motor (4) is mounted inside of the handle (1), a slider shaft (5) is mounted inside of the head case (3) to form an angle of approximately 90° with respect to the neck (2), a slider (6) which moves straight linear reciprocatingly along the slider shaft (5) is mounted, and the slider (6) and a motor (4) are coupled by a power linkage device (7) for converting rotation power of the motor (4) to a straight linear reciprocating movement of slider (6) and transmitting the converted movement, whereby direction of bone cutting performed by a saw member or a file member attached to the slide (6) forms an angle of approximately 90° with respect to an approach direction of the handle (1). Therefore it provides a significantly high efficiency in mandibular angle resection or other intraoral bone surgery since easily performed in a narrow space, ensuring a wide field of view. In addition, a portion like an upper cutoff portion of mandible angle to which a conventional saw has a difficulty in approaching, can be easily approached and cutoff.

WO 01/13802 A1

RECIPROCATING SAW FOR USE IN VARIABLE ANGLE AND MULTIPLE DIRECTION

Field of the Invention

The present invention relates to a unique saw for use in esthetic facial bone surgery, and more particularly, to a modified reciprocating saw for use in mandibular angle resection in which the mandibular angle can be resected by a linear reciprocation movement of saw blade without being restricted in approach direction.

Background Art

Several types of saw have been used in esthetic mandibular angle resection surgery. Since bone cutting operation is performed in a narrow space of oral cavity, it is required to minimize the saw used therein. In addition, optimization in bone cutting direction affects significantly to the degree of difficulty, required time period, and final outcome of the operation. However, conventional surgical cutting saws do not provide such an optimization.

As a conventional saw for surgical cutting operation, there is a conventional reciprocating saw of which saw blade is formed in the same direction as a handle thereof, as shown in FIG. 10, and an oscillating saw of which saw blade is formed to allow cuttings in perpendicular direction with respect to a handle of the saw, as shown in FIGs. 11a and 11b. The conventional reciprocating saw has a problem in that direction change is not easy and an external skin incision is required and an intraoral incision becomes large so as to ensure space required for insertion and bone cutting since the approach direction and bone cutting direction are the same. The oscillating saw has a problem in that efficiency of cutting operation is low since cutting movement is on a part of a circle, and determination on the direction for bone cutting is extremely difficult since approach and motion of the shaft are limited by adjacent structures.

For example, when a protruded portion of a mandible angle 100 has to be removed by being cut in a circular shape, the conventional reciprocating saw shows an excellent cutting force. However, as shown in FIG. 10, an additional incision 101 is required to be formed at an outer

skin, which delays recovery time period and makes surgical operation more complicated. The oscillating saw is advantageous in that the incision is made only in oral cavity (intraoral incision 102). However, as shown in FIG. 11a, when an upper portion of the mandible angle is cut-off (at point p), the saw handle and the shaft are caught by the limited intraoral incision 102 and the body of zygoma, which causes difficulty in determination on direction and angle.

A typical oscillating saw is employed when bone cutting operation is performed in an angle different from the direction of the saw handle. However, if the angle is not perpendicular to the handle, i.e., if the angle is not 90° with respect to the handle, a circular action is partially included, thus making cutoff operation inefficient. (referring to FIG. 11b, when cutting operation is to be performed in x-axis direction, efficiency of cutting operation is degraded since a circular action occurs, forming an arc at x-y surface)

Additionally, oscillating saw blade has limited width, so it is very difficult to cut the end of bone to be resected in the same direction with that of primary position.

Summary of the Invention

Therefore, it is an object of the present invention to allow an easy change in cutting angle in a narrow space, minimization in incision, and enhancement in an efficiency of intraoral bone surgery.

To accomplish the above object of the present invention, there is provided a new type of saw for use in intraoral bone surgery, particularity mandibular angle resection in which saw operation portion to be inserted has a minimized size so as to allow an effective use in a narrow space, and saw blade or file reciprocates linearly at a state maintaining a predetermined angle with respect to an approach direction, to thereby allow a free setup of bone cutting direction and angle.

Brief Description of the Drawings

FIG.1 illustrates a basic configuration of a reciprocating saw according to the present invention;

FIG. 2a illustrates an external shape of the reciprocating saw shown in Fig. 1;

FIG. 2b illustrates a reciprocating saw having two slider axes according to an embodiment of the present invention;

FIG. 3 is a perspective view illustrating a configuration of a slider coupling portion according to the present invention;

FIG. 4 illustrates a modified configuration of a reciprocating saw according to the present invention;

FIG. 5 illustrates saw blade and file adopted to the present invention;

FIG. 6 illustrates a reciprocating saw according to another embodiment of the present invention;

FIG. 7 illustrates a modified configuration of the reciprocating saw shown in FIG. 6;

FIGs. 8a and 8b illustrate still another embodiment of the present invention;

FIG. 9 illustrates a state where the reciprocating saw of the present invention is applied;

FIG. 10 illustrate configuration and use state of an conventional reciprocating saw; and

Figlla, 11b illustrate configuration and use state of an oscillating saw.

Detailed Description of the Invention

Referring to FIGs.1 through 3, a reciprocating saw of the present invention includes a handle 1, a neck 2 which is extended from handle 1, and a head case 3 coupled to an end of neck 2. In detail, handle 1 has inside thereof a motor 4, and head case 3 has inside thereof a slider shaft 5 which forms an angle of approximately 90° with respect to neck 2. Slider 6 is mounted to perform a linear reciprocating motion along slider shaft 5. Slider 6 and motor 4 are connected by a power linkage device 7 for converting rotation power of motor 4 into a linear reciprocating motion of slider 6 and transmitting the converted motion. Thus, a saw 8 or a file 9 attached to slider 6 performs a liner reciprocating motion.

Handle 1 is shaped as a cylinder to which force of an operator is applied when bone cutting operation is performed. Handle 1 includes inside thereof motor 4, and outside thereof a switch 1a which turns

on/off motor 4 so as to control the cutting operation.

Neck 2 connects head case 3 with handle 1, and is extended from handle 1 in such a manner that the size of neck 2 is minimized so as not to disturb the cutting operation when the saw is deeply inserted into an oral cavity. Components of power linkage device 7 are arranged inside of neck 2.

Neck 2 can be formed in straight line type, or in bent type if necessary, as shown in FIG. 4. In a bent type neck, it is possible to adjust a proceeding direction (approach direction) of the neck and a linear movement direction (bone cutting direction) of the saw blade by the bent angle of the neck.

Head case 3 is for ensuring movement space of slider 6, and structured to have a minimum size within a scope of allowing a minimum stroke distance of the saw, so that a smooth operation of the saw can be achieved when inserted into an oral cavity.

When the stroke distance of the saw is 2.5mm to 3mm (which is the same as the stroke distance of the slider; denoted as "L" in FIG. 1), the head case has width of approximately 5mm and length of approximately 12mm in sectional surface, thus ensuring movement space of the slider and the minimum stroke distance of the saw. Further, free control of the bone cutting direction and angle can be achieved.

Slider shaft 5 is installed inside of head case 3 in order to induce linear movement of slider 6. Here, slide shaft 5 is shaped as a hexagon in sectional surface so as not to be warped during a linear reciprocating movement of slider 6. When neck 2 is straight line type, slider shaft 5 may have a variation of approximately 90° with respect to neck 2, to thereby achieve a bone cutting direction in conformity with the shape of cutting portion of the bone.

The above-mentioned hexagonal shape of the slider shaft is for preventing a warpage during slider movement, and can be formed as a cylindrical shaft as shown in FIG. 2a, wherein two slider axes are arranged in parallel to each other so as to prevent a warpage.

Slider 6 performs a linear reciprocating movement along slider shaft 5 within head case 3, and has a hexagonal perforation 6a penetrating through a body of slider 6. Slider shaft 5 is assembled into perforation 6a.

At an outer surface of slider 6, a screw hole 6b is formed for a replacement mounting of saw blade or file.

Saw blade 8 or file 9 serves to cut bone, and has at an end portion thereof a coupling hole 8a or 9a so as to be coupled to slider 6 using a screw 10.

FIG. 5 illustrates saw blade 8 and file 9, both can have various shape if necessary.

In the present invention, various embodiments are possible according to the configuration of power linkage device 7 for converting rotation power to a linear reciprocating movement of slider 6 and transmitting the converted movement. Power linkage device 7 as shown in FIGs. 1 through 3 is those which converts rotation movement of motor 4 to a reciprocating movement of slider 6 using a linkage shaft 71a. Here, linkage shaft 71a is inserted into inside of neck 2, so that both ends of linkage shaft 71a can be supported by a bearing 71b. At such a state, one end of linkage shaft 71a is directly coupled to motor 4 while the other end of linkage shaft 71a has an expanded member 71c at which an eccentric groove 71d is formed. Slider 6 also has an eccentric groove 6c, and both bent ends of a pin 71e are inserted into eccentric grooves 71d and 6c, respectively.

In the thus-structured power linkage device, rotation movement of motor 4 is transmitted to linkage shaft 71a, thus providing pin 71e with an eccentric movement at an end of linkage shaft 71a. Then, slider 6 to which the eccentric movement of pin 71e is transmitted slides along slider shaft 5 and thus moves in linear reciprocation. Such linear reciprocating movement of slider 6 is transmitted to the file or saw blade attached thereto, to thereby perform bone cutting operation.

Such a power linkage device has an extremely simplified structure, providing conversion of rotation movement of motor into a linear reciprocating movement and minimization of neck size.

As shown in FIG. 4, a linkage shaft may be formed in a flexible cable shaft 71a', so that rotation thereof is enabled even when the neck portion is bent by a predetermined angle. This allows diversity of angle in approach direction and bone cutting direction.

The power linkage device shown in FIG. 6 has a structure in that the handle portion converts rotation movement of motor 4 to a linear

reciprocating movement at the slide using a link node.

That is, a gear element 72a connected to a rotation shaft of motor 4 converts direction of rotation movement of motor 4 into a right angle. Then, an eccentric wheel shaft 72b is coupled to an end of gear element 72a, and an L-shaped link 72c is employed inside of head case 3, so that the arrest point of link 72c can be fixed to head case 3 by a hinge 72d and the upper end of link 72c can be coupled to slider 6 by a hinge 72e. The lower end of link 72c is connected to the eccentric wheel by a rod 72f.

The above-described configuration is that eccentric wheel shaft 72b rotates in accordance with the rotation of motor 4, and rod 72f connected thereto performs crank movement up and down. Then, the crank movement is transmitted to a linear reciprocating movement by link 72c, thereby linearly reciprocating slider 6.

The above-described configuration is advantageous in that a gear element which is required for changing the direction of power is provided to a handle portion which is not directly related to a bone cutting operation. In addition, internal component of a head case to be directly inserted into bone cutting portion is formed of a thin plate, to thereby minimize size of the head case and handle portion.

FIG. 7 illustrates an embodiment where slider shaft 5 is slant with respect to neck 2. Here, bone cutting direction is varied by an angle of approximately 90° with respect to the approach direction, and the angle of 90° may be reduced if necessary. Such a configuration may be applied in regardless of the configuration of a power linkage device, and is effective for bone cutting in a narrow portion.

FIG. 8a illustrates configuration of a power linkage device for converting rotation movement of motor into a straight linear movement using a lever moving right and left. An eccentric wheel 73a is coupled to an end of motor 4, and a second slider 73c which performs straight line reciprocating movement along a slider shaft 73b is arranged inside of handle 1 and connected to eccentric wheel 73a. Slider 6 and second slider 73c are connected by a lever 73e having at a center thereof a rotation shaft 73d.

The configuration as shown in FIG. 8b is also possible, wherein the power linkage device is bent at a center thereof focused in rotation

shaft 73d.

In such a configuration, the eccentric wheel and the second slider constitute a cam element so that the rotation movement of the eccentric wheel can be directly converted into a straight line reciprocating movement of the second slider. In addition, the slider which constitutes a saw blade operation portion is provided with a straight line reciprocating movement by the lever which performs angular movement being centered at rotation axis 73d.

The above-described configuration is disadvantageous in that a neck portion thereof becomes more or less larger since displacement at both ends of the lever becomes larger. However, the head case is formed integrally with the neck portion so as to allow more smooth operation, and the width of the neck portion is increased in accordance with the displacement of lever being centered at the rotation axis which has least displacement, to thereby provide a wide field of view when performing operation.

FIG. 9 illustrates a state of cutting the protrusion of a mandible angle into a circular shape using the reciprocating saw of the present invention. Here, intraoral incision 102 is made first, and the saw blade is inserted thereinto. Then, the direction of the handle is appropriately adjusted in order to perform a cutting operation.

Therefore, it is easy to cut the upper end of mandible angle by using exchangeable long blade.

The direction of bone cutting to be performed by the saw blade is adjusted by means of appropriately adjusting the handle, and the direction of bone cutting forms approximately 90° with respect to the approach direction of the handle. Therefore, free change in direction being centered from oral cavity incision 102 as an axis is allowed, so that a desired cutoff operation can be rapidly performed.

Specifically, an approach to an upper cutoff portion which was difficult to be performed in a conventional oscillating saw can be easily performed.

In the present invention, direction of handle and saw blade can be varied within a scope of approximately 90°, so that the cutoff surface and angle of the handle can be suitably adjusted in accordance with change in angle of saw blade.

The present invention is advantageous in that size of saw blade operation portion is minimized to allow free operation and field of view in a narrow space of oral cavity, the rotation power generated at the handle can be converted into a straight line reciprocating movement of the saw blade operation portion, and the direction of bone cutting has an angle of approximately 90° with respect to the approach direction. Thus, a significantly high efficiency in bone cutting operation can be achieved since the bone cutting operation is performed by the linear reciprocating movement. Differently from a conventional reciprocating saw, the new reciprocating saw of the present invention allows smooth operation even in a narrow space, ensuring a wide field of view. The bone cutting surgery can be performed only by intraoral incision. In addition, a portion like an upper cutoff portion of mandible angle to which a conventional saw has a difficulty in approaching, can be easily approached and cutoff adopting the present invention.

Saw or file of the present invention can be replaced by each other. Therefore, it is possible to rapidly replace saw or file with each other in accordance with the shape of the cutoff portion.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A reciprocating saw for use in oral cavity bone cutting operation, in which said saw is made up of a handle, a neck extended from said handle, and a head case to be coupled to an end of said neck, a motor is mounted inside of said handle, a slider shaft is mounted inside of said head case to have an angle of approximately 90° with respect to said neck, a slider which moves straight linear reciprocatingly along said slider shaft is mounted, and said slider and a motor are coupled by a power linkage device for converting rotation power of said motor to a straight linear reciprocating movement of slider and transmitting converted movement, whereby direction of bone cutting operation performed by a saw member or a file member attached to said slider forms an angle of approximately 90° with respect to an approach direction of said handle.

2. A reciprocating saw for use in oral cavity bone cutting operation according to Claim 1, wherein said power linkage device is structured in that a linkage shaft is inserted into inside of said neck, so that both ends of said linkage shaft can be supported by a bearing, and one end of said linkage shaft is directly coupled to said motor while the other end of said linkage shaft has an expanded member at which an eccentric groove is formed, and said slider also has an eccentric groove, and both bent ends of a pin are inserted into said eccentric grooves of said expanded member and said slider, respectively.

3. A reciprocating saw for use in oral cavity bone cutting operation according to Claim 1, wherein said power linkage device uses a gear element connected to a rotation shaft of said motor so as to convert direction of rotation movement of said motor into a right angle, and an eccentric wheel shaft is coupled to an end of said gear element, and an L-shaped link is employed inside of said head case, so that an arrest point of said L-shaped link can be fixed to said head case by a hinge and an upper end of said L-shaped link can be coupled to said slider by another hinge, and a lower end of said L-shape link is connected to an eccentric wheel by a rod.

4. A reciprocating saw for use in oral cavity bone cutting operation according to Claim 1, wherein said power linkage device is

structured in that an eccentric wheel is coupled to an end of said motor, and a second slider which performs straight linear reciprocating movement along a slider shaft is arranged inside of said handle so as to be coupled to said eccentric wheel, and said slider and second slider are connected by a lever having at a center thereof a rotation shaft.

FIG 1

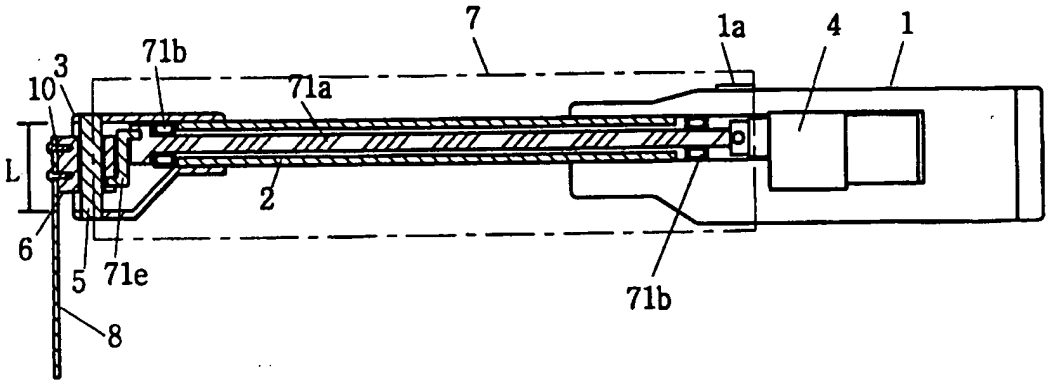


FIG 2a

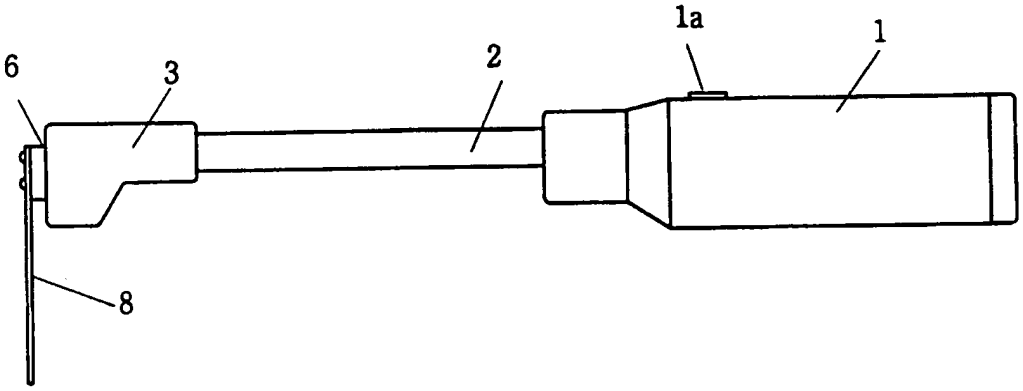


FIG 2b

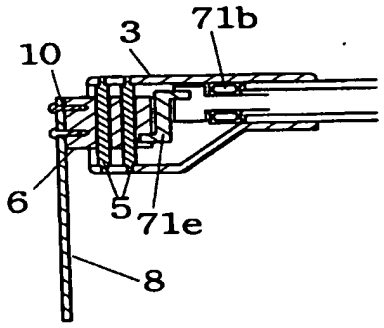


FIG 3

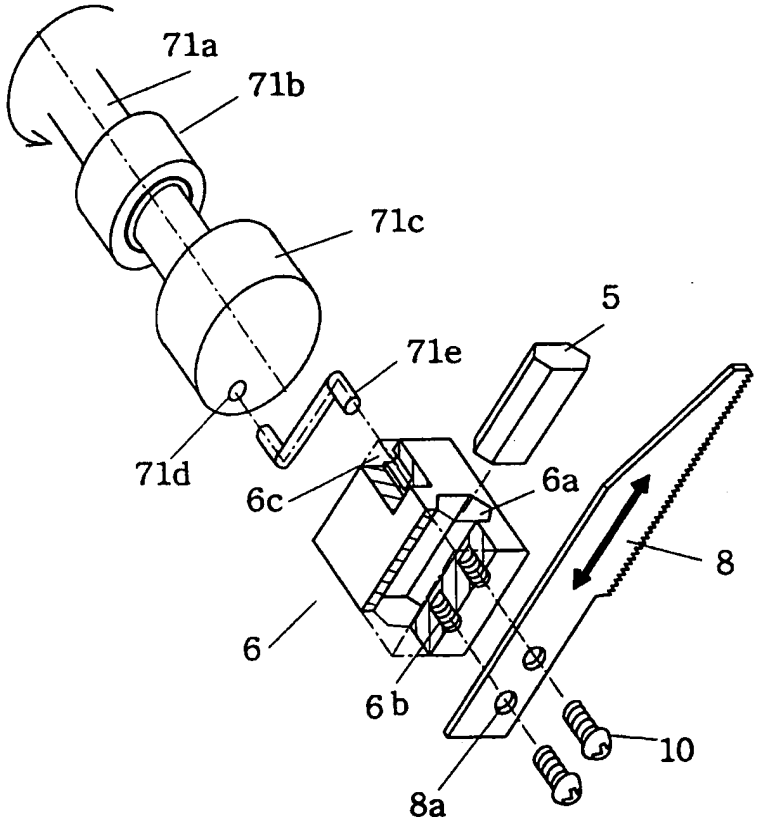


FIG 4

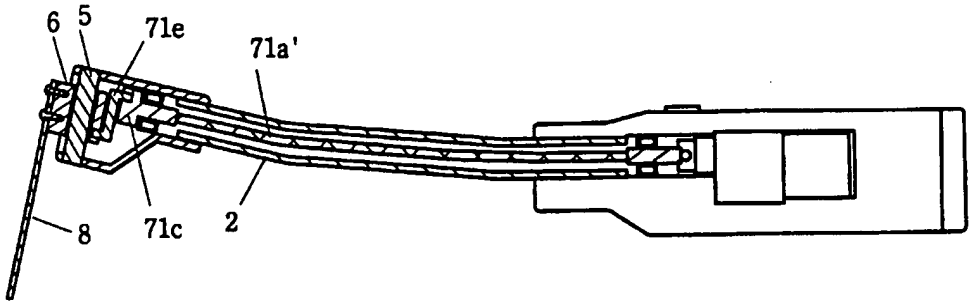


FIG 5

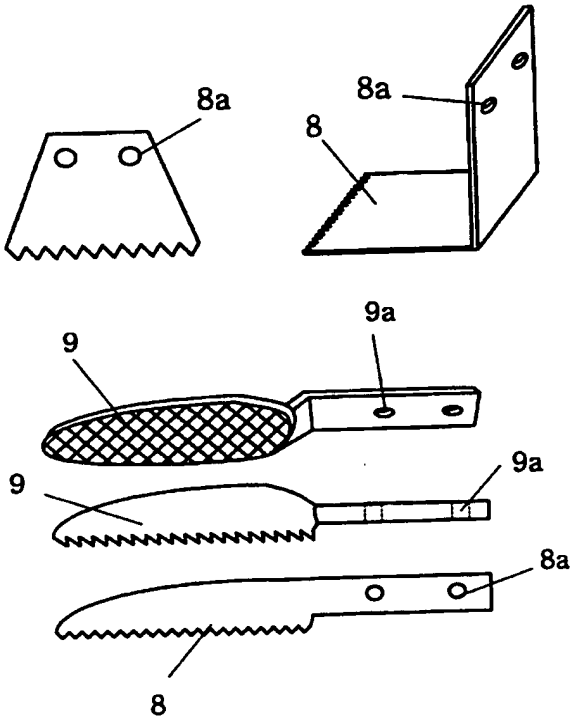


FIG 6

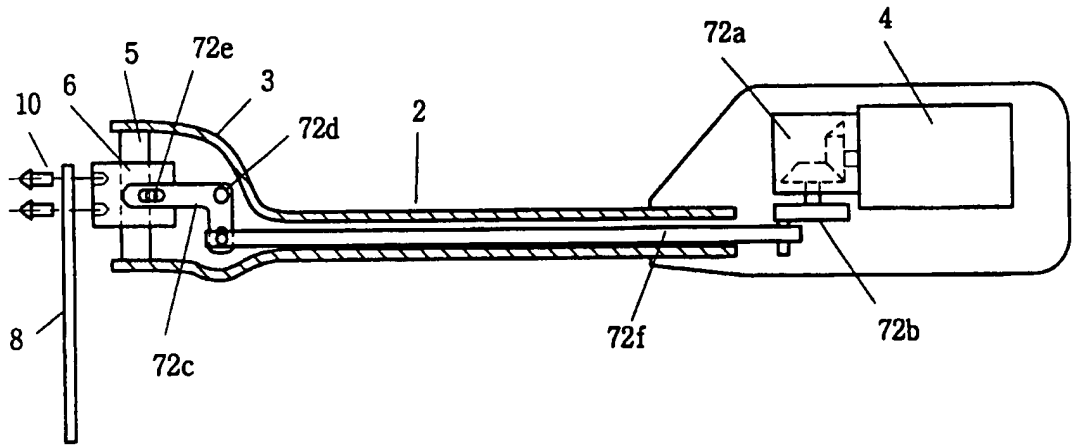


FIG 7

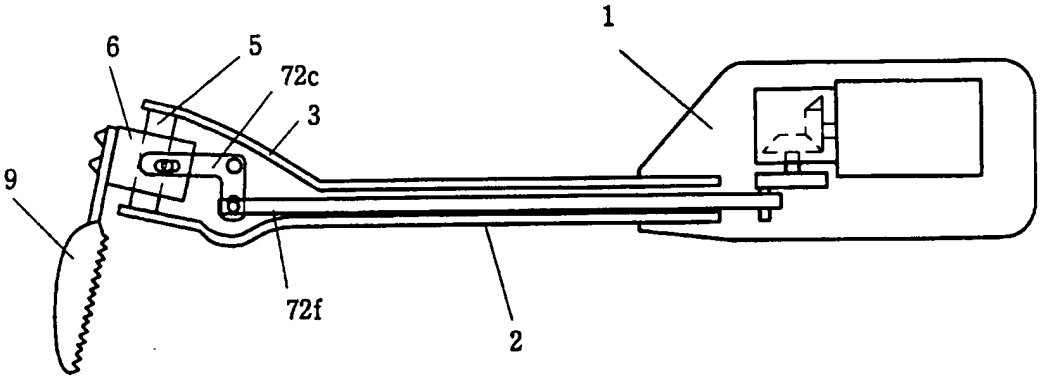


FIG 8a

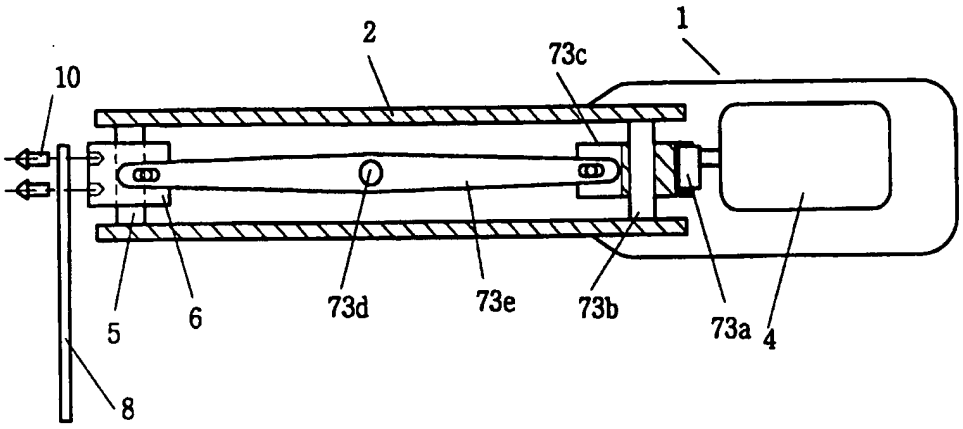


FIG 8b

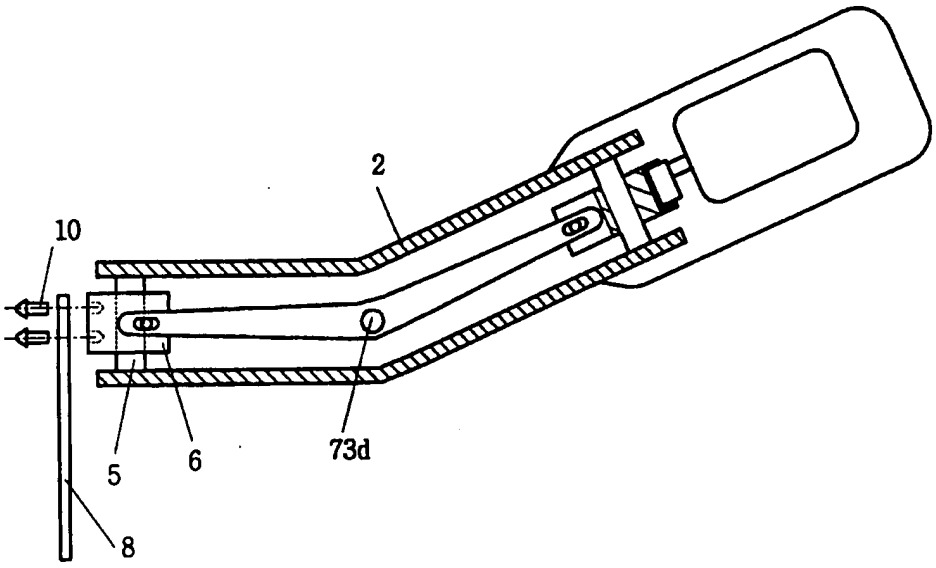


FIG 9

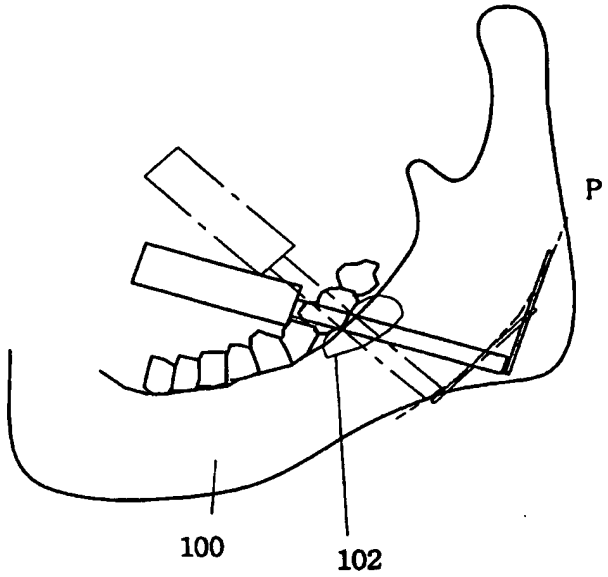


FIG 10

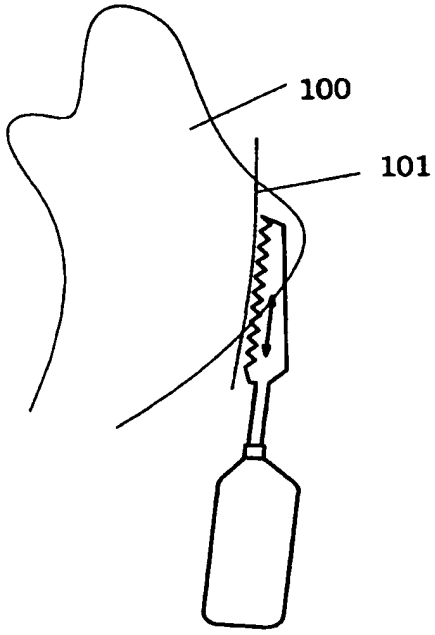


FIG 11a

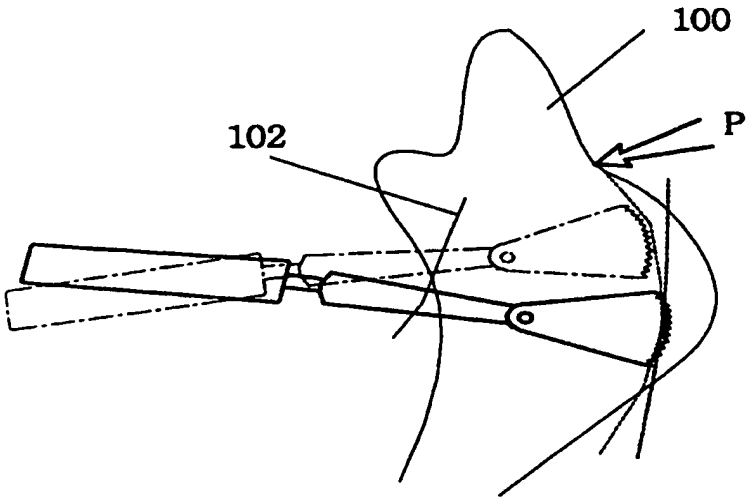
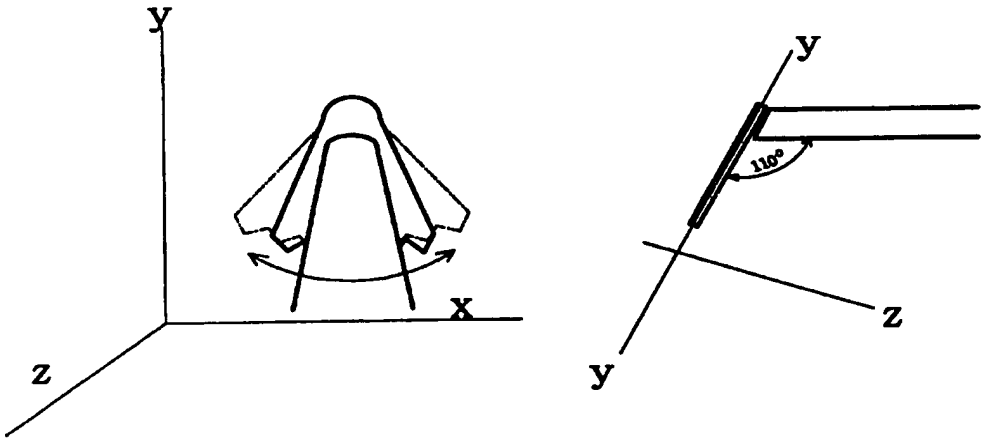


FIG 11b



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00717

CLASSIFICATION OF SUBJECT MATTER

IPC[7]: A 61 B 17/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: A 61 B 17/14, B 23 D 49/08, 49/10, 49/16; B 27 B 19/02, 19/04, 19/09

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 2749875 A1 (STORZ) 10 May 1979 (10.05.79) fig.1; claim 1; page 7, paragraph 1; page 8, paragraph 2.	1,4
A	DE 3712929 A1 (HEINL) 3 November 1988 (03.11.88) fig.1; abstract.	1
A	US 3642002 A (OTTERSTROM) 15 February 1972 (15.02.72) totality.	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

„A" document defining the general state of the art which is not considered to be of particular relevance

„E" earlier application or patent but published on or after the international filing date

„L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

„O" document referring to an oral disclosure, use, exhibition or other means

„P" document published prior to the international filing date but later than the priority date claimed

„T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 May 2000 (08.05.2000)	31 July 2000 (31.07.2000)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Ludwig Telephone No. 1/53424/349

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 99/00717

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
DE	A1	2749875	10-05-1979	none	
DE	C2	2749875	10-07-1986		
DE	A1	3712929	03-11-1988	none	
US	A	3642002	15-02-1972	none	